A

TEXT-BOOK

OF

ELEMENTARY SCIENCE

BOOK II

(ANIMAL LIFE)

(THIRD EDITION)

BY

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PREFACE

This hand-book on animal life is prepared in accordance with the syllabus on Elementary Science revised in May 1930 in the Madras S. S. L. C. Scheme. Practical exercises have been suggested at the end of the book, which, if carefully done, will not only give the pupils an insight into the subject but also develop their powers of observation. The language employed is simple and adapted to the standard for which it is intended.

Any suggestions for improvement will be gratefully acknowledged by the author.

KUMBAKONAM, 14-7-33. } K. S. RAMACHANDRA AIYER

PREFACE TO THE SECOND EDITION

The reception accorded to this text-book has been most favourable and the author tenders his warmest thanks to the teaching public for their patronage. He publishes the second edition and hopes that the same patronage will be continued.

THE AUTHOR.

PREFACE TO THE THIRD EDITION

A few new illustrations have been added in this edition.

THE AUTHOR.

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S. S. L. C. SYLLABUS

Animal Life

(1) Movement in animals, their variety and importance.—Fins of fishes; adhesive limbs of lizards; gliding of snake; swimming paddles of turtle; wings of birds; wings of bats; perching birds; legs of quadrupeds; limbs of cat, cow and horse with reference to their habits; flying butterfly; jumping locust; burrowing mole or cricket; clinging louse; slow creeping snail; burrowing earthworm.

(2) Food and feeding habits.—Jawless earthworm; blood sucking leech; leaf-eating caterpillar and grasshopper; honey-sucking butterfly; punching snail; chewing crab; toothed vertebrates; feeding in frog, fish, snake, a carnivorous bird, cud-chewing cow, non cud-chewing horse, carnivorous cat, gnawing squirrel; modifications of beaks in birds and teeth in mammals to suit carnivorous and herbivorous animals.

(3) Breathing in animals.—Gill breathing, fishes and crab; Lung breathing in higher animals.

(4) Special Coverings, such as a spines of porcupines and shells of tortoises and turtles. **Colouration**, for concealment or for aggression, colour changes, mimicry, horns; poison apparatus in scorpions, centipedes and snakes; irritating hairs in caterpillars.

(5) Life histories of animals.—Sex difference in birds; oviparous and viviparous embryo and its food in the two cases; care of the eggs and young ones in birds; care of young ones in mammals; life history of frog, butterfly and mosquito, their characters during the several stages.

(6) Animal Societies.—Ants and bees; members living in societies having a common cause; discipline among members.

GLOSSARY

Butterfly வண்ணாத்திப்பூச்சி
Caterpillar கம்பளிப்புழு
Centipede பூரான்
Chameleon பச்சோந்தி
Cobra நல்லபாம்பு
Crab நண்டு
Cricket சுவர்க்கோழி
Earthworm நாகப்பூச்சி: மண்புழு
Grasshopper வெட்டுக்கிளி
Hornet குளவி
Kite பருந்து
Krait கட்டுவிரியன்
Leech அட்டை
Louse பேன்
Lizard பல்லி
Mole-cricket பிள்ளைப்பூச்சி
Moth பட்டுப்பூச்சி
Porcupine முள்ளம்பன்றி
Reindeer கலைமான்
Scorpion தேள்
Sparrow சிட்டிக்குருவி
Stork நாரை
Tortoise ஆமை
Turtle கடலாமை
Vulture கழுகு
Wasp குளவிப்பூச்சி
Woodpecker மரங்கொத்திக் குருவி

ANIMAL LIFE

CHAPTER I

INTRODUCTION

Animate and Inanimate objects.—The things of this world are classified into two big groups, namely animate (living) and inanimate (lifeless) objects. Men and other animals and plants are called animate objects, as they possess life, while stones, soil, and water are inanimate objects, as they are lifeless. Animals and plants grow, but stones do not. Animate objects take food and water for their growth and possess distinct parts or organs: while inanimate objects do not grow but present the same appearance throughout. Another point of difference between animate and inanimate objects is that the former reproduce their own kind, while the latter do not.

Biology.—This is the general name given to the study of all living beings; and hence this branch of science treats of both animals and plants. Animal biology, or Zoology deals with the structure and activity of animals, but plant biology or Botany treats of the structure and activity of plants.

Classification of Animals.—Animals can be divided into vertebrates and invertebrates. Vertebrates are those animals which possess a backbone; examples:—frogs, birds, snakes, turtles, and mammals. These animals have a spinal column made of vertebrae. But invertebrates are those which do not have a backbone; examples:—worms, insects and oysters. The vertebrates are very familiar to us on

account of their size. In reality there are in this world more invertebrates than vertebrates. The invertebrates are subdivided into five distinct classes, the chief of them being worms, soft-bodied animals like the snail, and insects.

Insects.—We are all familiar with the class of animals called insects. They are found in large numbers in Nature. The moth, the butterfly, the grasshopper, the bee, and the ant are some of the insects we have to study. All insects are constructed on the same general plan. But there are certain peculiarities which distinguish one from another.

The word 'insect' means 'cut into'. The bodies of all insects are divided into three distinct parts, namely the head, the chest (or thorax), and belly (or abdomen). The thorax and the abdomen are composed of segments. So insects are segmented animals like the earthworm. There are generally three segments in the chest and nine in the abdomen. The segments are not complete rings, but are composed of two parts, the upper and the lower halves connected by a loose skin at the sides.

The Head.—The head is not segmented, but is all in one piece. It contains a pair of eyes, the mouth, and a pair of antennae which serve as feelers. The eyes are placed at the sides of the head to enable the animal to see in all directions. Each eye is not a single eye but is composed of a large number of small eyes and so is called a compound eye. God has provided the insects with such compound eyes to protect them from enemies. The two antennae are supposed to be organs of hearing and feeling. If the antennae are injured or torn, the insects will die in a few days. The shape of the mouth depends upon the particular kind of food which the

insect eats. The grasshopper which lives on vegetable food, has two lips and a pair of biting jaws. But the bee and the butterfly have no jaws but possess a kind of tube called proboscis, with which they suck up their food in the form of juice.

The Chest.—The middle portion of the insect is called the chest. It bears the wings and legs. There are two pairs of wings and three pairs of legs. The wings help the insect to fly, while the legs are useful in walking and jumping. Some insects, like the house-fly possess only one pair of wings, and instead of a second pair, they have a pair of balancers.

The Abdomen.—This forms the hind part of the body of the insect. It contains the organs of digestion and respiration. Insects have no lungs like us. The upper and lower halves of each segment of the abdomen are connected together at the sides by a loose skin which contains a large number of holes. These holes serve as organs of respiration. These are connected with the external openings of tubes spread inside the abdomen. Surrounding these tubes there are blood vessels. When the abdomen expands, air is taken into these tubes, and the blood in the blood vessels is purified. When it contracts, the carbonic acid gas given out by the blood escapes through the holes. The blood of insects is not red and warm, but cold and yellow.

The Vertebrates.—The vertebrates are divided into five classes namely fishes, amphibia, reptiles, birds, and mammals.

Fishes.—They are purely aquatic animals and so differ in form and structure from birds and beasts which live in air. They have no fingers or toes to creep about on land.

Amphibia.—The frog belongs to this class. It is called an amphibian (Gr-amphibious-living a double life) since it

lives a double life. In the early stage, it breathes by the gills, but in the later it breathes through the lungs. Other examples are newts and toads.

Reptiles.—Snakes, lizards, and tortoises are called reptiles (Repo : to creep) on account of their creeping mode of locomotion. The limbs are absent in snakes and some lizards. In other reptiles, they are so short and weak that they do not raise the body much above the ground. Fishes, frogs, and snakes are also called cold-blooded animals. Their temperature rises or falls with that of the surroundings, but never remains constant. They do not possess the warmth to hatch their eggs.

Birds.—These can be distinguished from other animals by their wings and feathers. It is the covering of the feathers which enable birds to maintain a temperature higher than that of the human body. The normal temperature of the human body is 98·4 ° F., but birds generally are found to have a temperature of 100° F. and even more. Hence birds are called warm-blooded animals. They lay eggs and hatch them with the warmth of their body. They feed their young ones with food.

Mammals.—They form the highest group of animals. They include man and other animals that bear the greatest resemblance to man. They nourish their young on milk produced in certain organs called mammary glands found on their breast.

CHAPTER II

MOVEMENTS IN ANIMALS: THEIR VARIETY AND IMPORTANCE

From a study of the classification of animals, we find that the animal kingdom includes a large number of forms varying in size, shape, and nature. In this chapter, we are going to study a few types of animals with special reference to their movement. All animals move about freely either to secure food or to protect themselves, from their enemies. The earthworm and snail have no special appendages for locomotion but still they move about. The fishes live in water and so possess special organs for locomotion. Birds are fitted both for areal life and life on land. A frog swims in water and hops on land. Its bodily structure is adapted for both kinds of movements. There is some connection between the bodily structure of an animal and its mode of movement. We shall see, in detail, how these two are correlated in the few types of animals we are going to study.

THE BURROWING EARTHWORM

Earthworms are generally found in moist places, gardens, and fields. After a heavy rain, they are generally seen on the surface of the ground in large numbers.

External Features.—The earthworm possesses a round elongated body tapering at both ends and is divided into a series of rings called **segments**. The upper surface is reddish brown, while the lower is greyish white. The front end has an opening which serves as the mouth, while the hind end has

a vent through which waste matter is expelled. About one-third of the way from the mouth, there is a broad ring called **clitellum**. If the animal is drawn gently from the tail to the head, it is somewhat rough. This is due to the bristles or **setae** present in each segment projecting backwards.

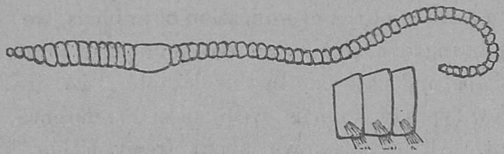


Fig. 1.

Movement.—Within the body of an earthworm, there are muscles by means of which it can contract easily. These muscles exist in two layers, one inside the other. In the outer layer, the muscles run circularly ; in the inner layer, they run lengthwise. The contraction of the circular muscles makes the body long and thin, while the contraction of the other layer makes it short and thick. Whenever the animal moves, it first fixes its front end on the ground and drags its hinder part. Then it pushes the front end forwards, and it elongates. This process of contraction and elongation is repeated. During these movements, the setae help the animal from slipping backwards and act as pivots.

The earthworm lives in its burrow, and leaves it only during the night. Its sensitive skin warns it of the approach of enemies, and it at once retreats into the burrow. During very hot seasons and frosty weather, it descends deeper into the burrow and remains there awaiting favourable conditions. It generally covers the mouth of the burrow with twigs and leaves to prevent its enemies from preying

upon it and at the same time to get its supply of air. Its food is composed of decayed vegetable matter, and so it can remain in its burrow for any length of time.

THE SLOW CREEPING SNAIL.

Garden snails are found very rarely during summer. Occasionally they are seen on the back of leaves in our gardens. But during the wet season, they are met with often during the day, though they usually go out only in the night.

External Features.—The snail has on its back a spiral shell, which protects its fleshy body. The shell is composed of calcium carbonate and resembles an inverted top. The snail possesses a head bearing two pairs of tentacles, one pair being shorter than the other. The shorter pair serves as feelers.

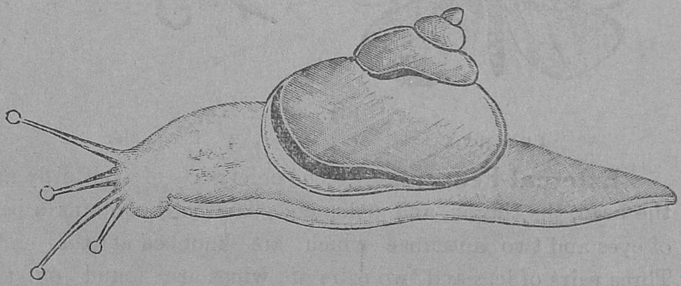


Fig. 2.

The two longer tentacles carry eyes, and hence are called **eye-tentacles**.

Movement.—The snail creeps forward on its soft fleshy foot by the alternate contraction and relaxation of the muscles in it. It prefers a smooth surface to crawl along, and that is why it is generally found on the surface of a leaf. As it moves, it pours out a kind of slimy fluid which helps it to crawl

along or slide easily. If it is made to move cn a glass sheet, the dried up slime track can be seen clearly. The slimy fluid which it secretes becomes dry during the hot season and so it does not come out during that season. The animal cannot change its speed, nor can it move back. At the approach of enemies, it withdraws itself into its shell.

THE FLYING BUTTERFLY.

Butterflies are seen fitting from flower to flower during bright sunshine. They are so beautifully coloured that we see young boys running after them eager to catch them.

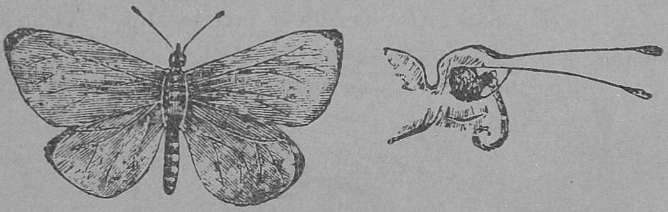


Fig. 3

Butterfly. Proboscis.

External Features.——The chief parts of a butterfly are the head, the thorax, and abdomen. The head contains a pair of eyes and two antennae which are knobbed at the ends. Three pairs of legs and two pairs of wings are found on the thorax. The butterfly has certain peculiarities by which we can distinguish it from other insects easily. The wings are beautifully coloured and relatively large. The colour is due to the minute scales covering the wings as fine dust. They come off readily when touched with the fingers. Another chief characteristic feature of a butterfly is that it has a sucking tube called proboscis in place of the mouth. When it is not in use, it is rolled into a coil.

Movement.—Its legs are long and slender, and so not, sufficiently strong to enable it to walk. At the tip of the foot, there are two curved claws which help it to cling to the plants on which they generally alight. The two pairs of wings enable the insect to fly from flower to flower.

THE JUMPING LOCUST

We are all familiar with the green insect which leaps about among grass. It is called the grasshopper as it performs extraordinary feats of jumping.

External Features.—The body of the grasshopper is composed of three distinct parts, namely the head, thorax, and the abdomen. The head contains a pair of antennae and a pair of compound eyes. There are two pairs of wings on

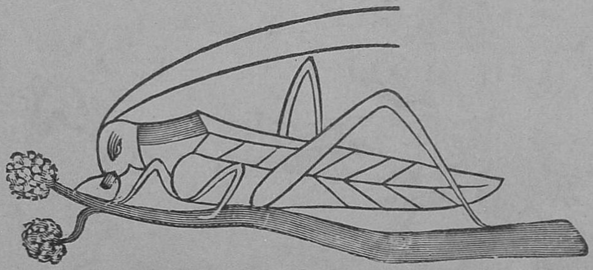


Fig. 4.

the upper half of the thorax and three pairs of legs on the lower half.

Movement.—The insect is able to jump with the help of the hind legs, which are long and muscular. When it jumps it presses them on the ground and suddenly straightens them. The front pair of narrow wings is not of much use to the insect in flight. It is only with the help of the broad hind pair that flight is accomplished. When at rest they are

folded like a fan and covered over by the front wings. The locust is allied to the grasshopper.

THE CRICKET

The cricket is a relative of the grasshopper, since it possesses the same structure and habits. There are two kinds of cricket, the field cricket and the mole cricket. The field cricket does not burrow. It is only the mole-cricket that burrows underground. It uses its front legs for burrowing. They are strong, broad, and flat. The foot has four spades with which the insect can dig the soil. The sharp claws help it to scoop out the sand quickly and cut the roots of plants on the way. The thorax has an oval hood with which it enlarges and shapes the burrow. The last pair of legs are long, and so the insect is able to make short leaps. It is generally seen going along damp places in search of food.

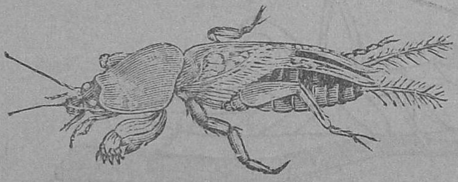


Fig. 5.
Mole Cricket.

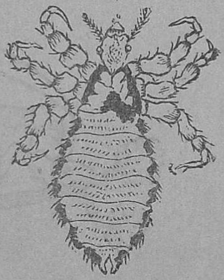


Fig. 6.
Louse.

All crickets have two pairs of wings which help them in making short flights.

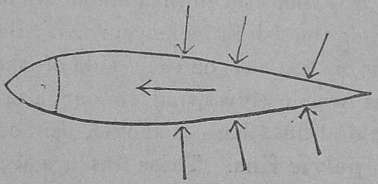
THE CLINGING LOUSE

It belongs to the class of insects, since it has a head, a thorax, and an abdomen. It is flat in form and has three pair of legs with bristles grown all over. At the end of each leg,

there is a hooked claw. But the insect has no wings and so cannot fly. It is generally found clinging to the hair with its claws. It seizes the scalp with its jaws and sucks blood by means of its telescopically extensible snout.

THE FISH

External Features.—We find in a fish three distinct regions, the head, trunk, and tail. There is no neck, and the head is directly connected with the trunk. The body of a fish tapers at both ends. Its shape resembles that of a boat and helps it to move through water with the greatest possible ease. The body is covered with scales which are kept smooth



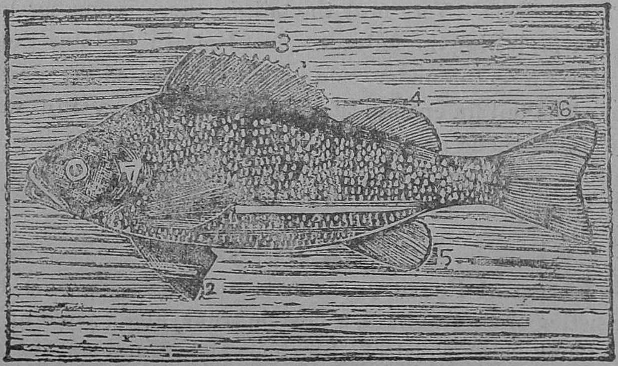


Fig. 7.

1 and 2 : Paired Fins. 3, 4 & 5 : Unpaired Fins. 6 : Tail fin. 7 : Gills.

and slippery by a kind of slimy substance. These scales point backwards and overlap one another and so do not cause any resistance during movements in water. They also form a kind of protective covering over the body.

Movement.—We have seen that a boat is propelled by oars. A fish is provided with certain organs called fins. These are attached to the body of the fish and help it to swim in water. The chief organ of locomotion of a fish is its tail which is composed of a broad fin fringed at the posterior end with bony rods called **fin-rays.** The tail fin is flexible and is moved from side to side, when the fish moves forward. There are also other fins about seven in number which are useful to balance and guide the fish in its movements. Behind the head, there is a pair of fins one on each side of the breast called **pectoral fins** which correspond to our arms. Below and behind the pectoral fins, there is another pair corresponding to our legs called **pelvic fins**. These fins are also called paired fins since they exist in pairs. Besides these, there is a large fin on the back. Very near the tail fin, there is another much smaller fin having no fin-rays. Just beneath this fin, there is another fin on the under side of the body called the **ventral fin.** The tail fin enables the fish to move forward in water. The pectoral and pelvic fins serve as balancers and are often used for rising or descending while the unpaired dorsal and ventral fins act as keels.

THE SNAKE

External Features.—A snake possesses a long body consisting of an oval head, a flexible trunk, and a tapering tail. The trunk is composed of a backbone and several pairs of ribs. The whole body is covered with overlapping scales. The eyes are small and have no eyelids. The tongue is forked and serves only as feelers.

Movement.—Though the snake is devoid of limbs still it moves very swiftly and easily. How is it able to do so? The backbone is made up of a large number of bones connected together by ball and socket joints. It is therefore flexible. Again to each bone is attached a pair of curved ribs. One end of each rib is attached to the backbone by a ball and socket joint, while the other end is free. The ribs and backbone are capable of movement in all directions. Hence the trunk is flexible. The overlapping scales also help the animal in its movement. The scales on the under part of its body are larger than the rest, and are connected with the free ends of ribs by strong muscles.

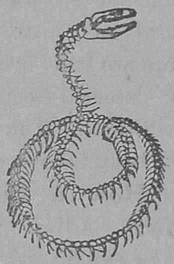


Fig. 8.

During movement, the ribs first move forward and drag the under scales along with them. These grip the ground, and the body is drawn forward with a gliding motion.

THE HOUSE LIZARD.

Lizards are commonly seen running on the roofs of houses and beams. Sometimes, they are not even visible to us as

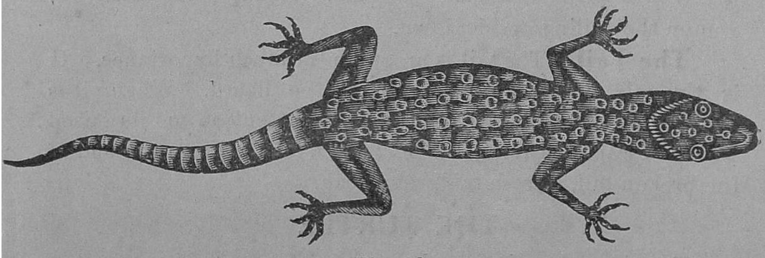


Fig. 9.

their colour harmonises with surroundings. Their colour has a protective value. They hide themselves in corners during

the day, but at night they start in search of food which consists of fly, mosquito, and other insects.

External Features.—A lizard's body consists of three parts, the head, trunk, and tail. The head is triangular in shape and is connected with the trunk by a broad neck. The lizard has a pair of eyes on the head. Just behind the eyes there are two openings which form the ears. The lizard has no external ear. The two jaws are provided with a row of small teeth. The trunk has two pairs of limbs at its sides. The body is covered with scales.

How a Lizard Walks on the Ceiling upside down.—A lizard has four legs. Each leg has five fingers, and at the end of each finger there is a claw which enables the animal to cling to the walls. Beneath each toe, there is a special mechanism which consists of a plate-like structure. When the foot is pressed against the wall, the plate-like structures are also pressed. They become broader, and the result is that the pressure beneath is less than the outside air pressure. Hence the reptile can run on the ceiling upside down.

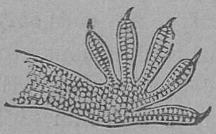


Fig. 10.

The Tail.—The tail is an organ of much importance. It is the only weapon of defence of the lizard. When it is attacked by enemies, it invites their attention to its raised tail and escapes leaving it in their hands. From the end of the broken tail, a fresh tail grows soon.

THE TURTLE

Tortoises that live in the sea are spoken of as turtles. They belong to the class of reptiles. The trunk of a turtle is covered by a shell. It has two pairs of legs which are movable

and can be drawn within the shell for protection. In addition to the webbed hind feet, the anterior limbs are broad and flat and are changed into paddle shaped flippers useful for swimming in the sea. So turtles are powerful swimmers.

WINGS OF BIRDS

The Skeleton of a Bird.—The pigeon has a long backbone to which several bones are attached by means of joints. There is a broad flat bone in the middle of the chest. This is called the breastbone and it has all the great muscles used in moving the wings during flight. In all animals, we find two pairs of limbs, the forelegs (or arms) and the hind legs. You have seen that a pigeon has a pair of legs. Does it possess arms or forelegs? It may seem to you at first sight that it has no arms. This is not true. The wings in the pigeon take the place of arms. The bones of wings consist of three parts, the upper arm, the forearm, and the hand. Each is altered slightly to serve the purposes of a wing. The bones are all covered with muscles, and the bird can fold and unfold the wing. The muscles of the breast bone cause the wing to make upward and downward strokes in flight.

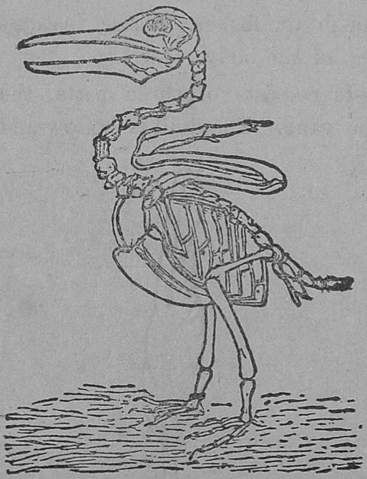


Fig. 11

Wings and Feathers.—There are three kinds of feathers the quill feathers, covert feathers, and downy feathers. The feathers help the bird in flight, and the wings are composed of them. The covert feathers are also called the contour feathers. They are found at the bottom of the quill feathers covering the bird's body and giving it a regularly rounded shape. If these two kinds of feathers are removed from the body of a pigeon, we find beneath them another set of soft feathers, the downy feathers covering the whole body. They cannot be plucked by the hand, and flesh eaters remove them by passing the bird through the flames. These feathers are useful in preserving the heat of the body.

The Quill Feather.—It consists of three parts, the quill, the shaft, and the web or vane. The quill is hollow and

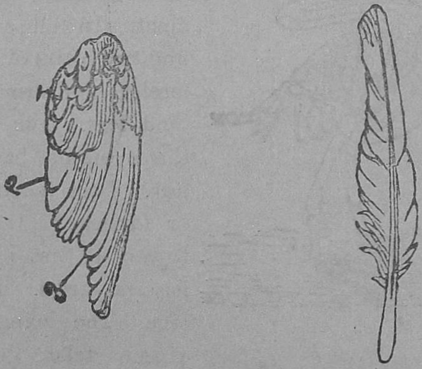


Fig. 12.

1. Downy Feather. 2. Covert Feather. 3. Quill Feather.

round. It is thin and light and is composed of a tough horny substance. Its root is fixed in the skin of the bird. The shaft is the continuation of the quill and is as horny and elastic as the quill. It is not hollow but made of a white

substance called pith. The shaft bears on each side delicate leaves called barbs arranged with their flat sides close together. It is not easy to separate them, and when they are separated, they can be readily re-united.

Flight.—The wings are moved up and down by the action of the muscles attached to the breast-bone. They can be folded and unfolded by the contraction of the muscles of the bones of the arm. When the outstretched wings are pulled down by the muscles of the breast-bone, a large resistance is offered to the air on account of the wonderful linking of the adjacent barbs. The resulting reaction propels the bird upward and forward. In the upward stroke, the resistance of the air is diminished, as the air can pass freely on account of the separation of the feathers. Change of direction is effected by the tail feathers which act as rudder. The bones of the pigeon are hollow and contain air, and so are very light. This helps the bird in its flight to a great extent. Again, the pigeon's tapering body is well fitted for rapid motion through air.

Perching Birds.—The pigeon, the sparrow, and the crow belong to the class of perching birds. They are called

Fig. 13. Sparrow.

perchers, since they can easily perch on the branch of a tree on account of the structure of their legs. There are four toes in each foot, three of them being directed forwards and one backwards. When the bird sits on the branch of a tree, the

knee bends on account of its weight. The toes clasp the support and cannot unclasp it as long as it is in its perching position. When it raises itself to fly, the curved toes leave the support.

WINGS OF BATS

Though bats belong to the class of mammals, still they are provided with wings and have an aerial existence. Their wings differ from those of birds. The wing of a bat consists of a broad leathery skin on each side of the body and does not possess feathers. It extends from the fore-limb to the hind-limb. There is also

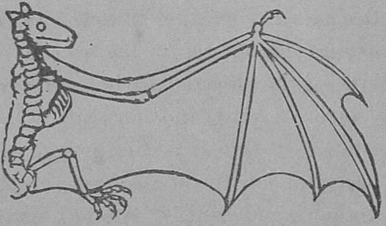


Fig. 14.

another membrane stretched between the legs used by some bats as a kind of sac for striking moths. The wing is supported by the long forearm and the long fingers. The thumb of the hand is free and has a claw. The toes of the legs are also provided with sharp claws bent like hooks. The skeleton of a bat is very light, and the bones of the limbs have large cavities.

Bats are seen flying about during nights in search of food. During the day they hang from the branches of trees and rafters of old buildings with their heads downwards with the help of the claws. The wing is very sensitive and enables the animals to avoid obstacles. This compensates for their defective eye-sight.

Bats are of two kinds, namely, the fruit-eating bats and the insect-eating bats. The latter are small and are useful to

man, since they destroy the insects harmful to him. The former are called flying foxes, since their faces resemble those of foxes.

LEGS OF QUADRUPEDS

Movement.—The limbs of mammals are wonderfully adapted to their habits and environment. The cow, the horse, and the cat belong to the class of mammals. They have four legs and hence are called quadrupeds. The hind pair of legs is longer and stronger than the front pair. A horse has only one toe on each foot, while a cow has two toes. The nail on the toe is developed into a hoof. So these animals are called

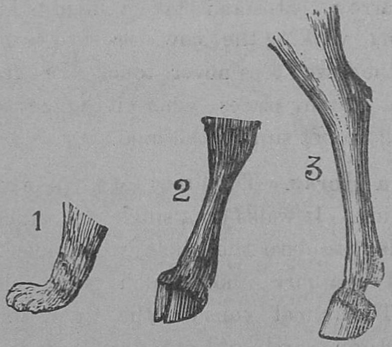


Fig. 15.

1. Leg of a Cat. 2. Leg of a Sheep. 3. Leg of a Horse.

hoofed animals. A horse walks on a single toe, but a cow walks on two toes. The muscles of the limbs are arranged in such a way that maximum speed is attained with minimum muscular exertion. Swift animals like the deer and the horse have their legs close to one another. But elephants have their legs wide apart. They have a heavy body and cannot run swiftly. Hoofed animals are good runners. We have seen that people who compete for running races run on their

toes or digits and do not plant their feet. So hoofed animals which run on their digits are called **digitigrades**. But animals like the bear which plant their whole feet on the ground are called **plantigrades**. The foot of an elephant is flat and well adapted for trampling down bushes and grass.

Legs of a Cow.—The cow is a swift-footed animal, but its bulky body retards its speed. It has short, stout, and strong legs to support its heavy body. There are four toes in each foot, two large ones in front and two short ones behind. Each toe is covered by a hard horny hoof. The hoofs are cloven and the cloven hoofs help the animal to maintain the balance on narrow paths and take a firm hold of slippery places. During walking the cow uses the two large toes in front. The other two toes never touch the ground. It can easily walk on marshy places where it grazes by spreading its hoofs which do not sink in the mud.

Legs of a Horse.—The limbs of a horse are best fitted for swift running. It walks on a single toe which is long and stout to enable it to bear the whole weight of its body. The toe is enclosed in a horny hoof which is not cloven like that of the cow. The animal runs on the tip of this single toe. When it travels on sandy soil, the toe sinks in the sand and retards its speed. The toe frequently becomes worn out on account of long travel and is often shod. Sometimes the horse uses the toes for self-defence. When it cannot run away from its enemy, it kicks him with its hind legs.

Legs of a Cat.—The cat is a flesh-eating animal. It possesses short and slender legs, each leg ending in powerful claws which can be drawn in or out at will. The claws are useful not only in seizing the prey but also in climbing up trees in search of birds or their eggs. The animal is provided

with soft pads under the feet which help it to move noiselessly and alight gently after a spring. Its eyes are wide open and can see in the dark. Hence it is easy for it to catch the rats which run away at the slightest noise and form a source of nuisance to us.

CHAPTER III

FOOD AND FEEDING HABITS

In this chapter, we are going to study the food and feeding habits of the few animals mentioned in the previous chapter. Food is quite necessary for the preservation of life in an animal. All animals do not take the same kind of food Some take vegetable food while others take animal food. We shall see how the mouth parts of animals are fitted to the kind of food they take.

JAWLESS EARTHWORM

The earthworm (Fig. 1) has neither jaws nor teeth. Its food consists of decaying vegetable matter found in earth. Whenever it makes burrows, the earth passes through its body. The vegetable matter in the earth is acted on by certain liquids manufactured by the worm and is digested. The rest is ejected in the form of castings.

The earthworm is an invaluable friend of the farmer. A large quantity of mud is ejected out of its body every day in the form of castings. These castings, being made of finely divided earth, serve as rich manure for plants. Again, when the earthworm makes burrows in the ground, air, light and water can enter into the soil freely ; and the roots of plants can penetrate with ease. Hence it is economically important in the scheme of Nature.

THE LEECH

The leech is a relative of the earthworm and is found in tanks, lakes, pools, and marshy places. The body is wormlike and segmented. The animal can be recognised by the possession of a cup shaped disc called the sucker at each end of the body. The suckers serve as organs of adhesion. When they are applied to anything and pressed, a vacuum is created inside and the leech is able to adhere to that object. It has no setae but makes looping movements by using the suckers. It sucks the blood or the juices of other animals, usually of vertebrates. It crawls rapidly on land and swims in water with great ease.

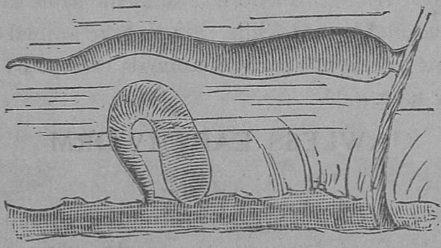


Fig. 16.

The mouth is at the anterior end and contains three jaws with teeth which are notched like a saw. The blades of the teeth pierce the skin of other animals. The leech sucks up the blood which flows out. The blood is stored in the stomach which is a kind of elastic bag. It can remain without clotting for several days. This is due to the secretion of the salivary glands of the leech.

THE PUNCHING SNAIL.

The snail (Fig. 2) lives on green leaves. During nights, it comes out and eats away the tendrils of plants. It has a strong

horny upper jaw. There is a tongue within the mouth covered by rapsy ribbon called radula with which the leaves are minced and taken in. Rows of sharp teeth are arranged on the radula one behind the other.

HONEY SUCKING BUTTERFLY

The chief food of the butterfly is honey which it gathers from flowers. It is generally seen during day time going from flower to flower in search of honey. Whenever it rests on a flower, it folds its wings vertically over its back. If it rests on it with wings horizontally, it can be easily distinguished from the flower by the bright colour. The habit of folding its wings vertically over its back has a great protective value. It has no biting jaws but the two jaws are lengthened to form a sucking tube called proboscis. After resting on the flower, it stretches out the proboscis, directs it deep into the flower, and sucks up the honey. When not in use, the proboscis is kept cailed like a watch-spring under its head. See Fig. 3.

LEAF-EATING CATTERPILLAR AND GRASS-HOPPER

Catterpillars are worm-like creatures coming out of the

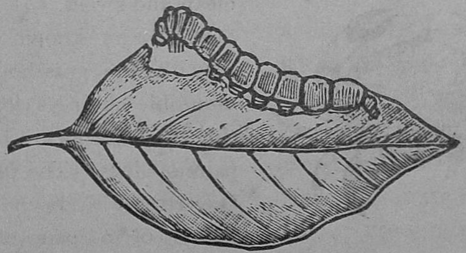


Fig. 17.

eggs of butterflies and moths. They are found on the leaves

of trees and plants everywhere. Both the caterpillar and the grasshopper feed on leaves. The grasshopper, in addition, eats flies. The jaws and teeth of both are more or less alike. Their mouth parts are constructed in such a way that they are useful in biting and chewing. They contain an upper and a lower lip and two pairs of jaws. One pair of jaws known as mandibles is situated behind the upper lip. Behind these is the other pair of helping jaws known as maxillae. The two lips move up and down, while the two pairs of jaws move sideways. These help the insects in biting and crushing the leaves of grass or other plants. Both the insects are garden pests.

Since grasshoppers feed on grass and grains, they are generally found in grassy meadows and paddy fields. One kind of grasshopper known as the locust causes considerable destruction to plant life, and sometimes brings on famine. Northern India suffers from such locust invasions.

THE CHEWING CRAB

The crab is found in large numbers in the seas and in fresh water. If feeds mostly on dead animals and so is a scavenger keeping the waters clean and sweet. It has a pair of hard jaws known as mandibles like the grasshopper, each mandible having a few teeth a the inner borders. It has five pairs of legs. The first pair is the largest and ends like the points of a pair of pincers. The crab seizes its food with the pincers in the front limbs and chews the food by reducing it with the mandibles to pieces small enough to be eaten.

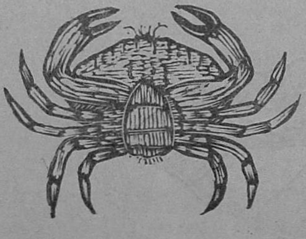


Fig. 18.

TOOTHED VERTEBRATES

All the vertebrate animals except birds possess teeth in their jaw bones. We shall see how the arrangement of teeth helps the animal to obtain its food.

How the Fish Feeds.—Fishes feed on animals and plants found in water. On examining the mouth of a fish, we find that it is provided with a large number of small teeth pointing backwards. They are not fit either for tearing or grinding. Fishes catch their prey, and with the teeth, hold them fast, and then swallow them. The mouth is large. The jaw bones are loosely joined enabling the animal to widen the mouth to catch a large prey.

Fishes have their eyes constructed in such a way as to enable them to see under water. The eyes are large and have no eyelids. So fishes appear to be wide awake always. Their sense of smell is in the nostrils situated in front of the eyes. Since they are not connected with the mouth, they serve only as organs of smell. The ears are present within the head. Fishes have only internal ears and no external ears. But these are supposed to serve as balancing organs rather than organs of hearing.

How the Frog gets its food.—It has been said in the introductory chapter that the frog is an amphibian. It

Fig. 19.

hops on land and swims in water. Its mouth is wide and is bounded by two jaws, the upper jaw alone bearing teeth. The

tongue is large and slimy and unlike our tongue is attached to the front end of lower jaw. It is worked by a powerful muscle and its tip ends in two lobes.

The food of a frog consists of insects, fishes, and other frogs. It catches its prey with the help of the slimy tongue. You may have seen a frog lying in wait for its prey. As soon as an insect comes in front of it, its long tongue is shot out of the mouth very quickly and then drawn back with the insect sticking to it. When its prey struggles to escape, the teeth hold it securely. The frog swallows the food without chewing it.

How a Snake Feeds.—A snake feeds on frogs, lizards, and rats. It swallows them whole. Its mouth is made up of two jaws which can be opened widely. The jaw bones are attached in such a way as to enable the animal to widen the jaws sideways and vertically. Each jaw is furnished with several small sharp teeth pointing backwards as in the case of the frog. Even when the prey is larger than the size of the snake, the mouth is widened, and the pointed teeth prevent it from escaping. It is swallowed whole and goes downwards by distending the flexible trunk to a great extent. The gastric juice of the snake is strong enough to dissolve bones.

BEAKS IN BIRDS AND TEETH IN MAMMALS

Carnivorous Birds.—The kite, the owl, and the vulture are examples of carnivorous birds. They feed on the flesh of animals. The kite feeds on fish, frog, chicken, and snake. Its legs and beak are adapted for seizing its prey and tearing it to pieces. Its toes are four in number, three of which are directed forwards and one backwards. Each toe is provided with sharp hooked claws. The beak is strong and pointed, the upper part being hooked and hence fit for tearing

flesh. As soon as the kite sees its prey, it pounces upon it, seizes it with its claws, and carries it away. It then kills it

Fig. 20

with its strong beak, cuts it to pieces, and swallows them. The owl and the vulture also possess similar organs for seizing their prey.

Water Birds.—The duck is a water bird. It gets its food from water. It has webbed feet which enable it to swim easily. Fish and other water insects form its chief food. It cannot walk on ground with the ease with which it swims in water. Its beak is long and flat. Each edge of the beak is provided with fringes which act as strainers. If the mandi-

Fig. 21.

bles are opened, the tongue becomes visible. It is also provided with fringes like those of the beak. When fishes hide themselves deep in the mud, the duck searches them with its beak. It takes a mouthful of muddy water and closes its mouth. The mud and the water come out at the

sides, while the fringes prevent the escape of worms and fishes and act as a trap. Other birds which belong to this class are the swans and geese.

The Stork.—The stork is a bird which belongs to the class of water birds; but it does not possess webbed feet and

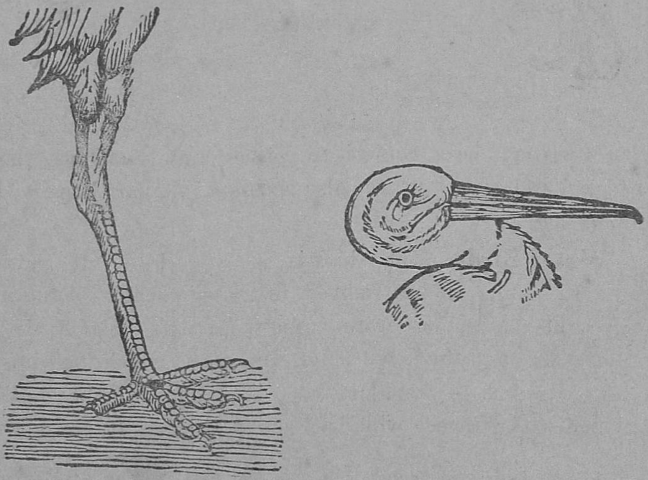


Fig. 22.

a flat beak like those of the duck. It does not swim in water but walks along its edge in search of fish and other insects for food. It has long legs, each leg being provided with four toes. The three front toes are long and the back toe is short. Its long legs enable it to wade through water a short distance to catch its prey. Sometimes, it sits on lotus leaves and walks along marshy places in search of food. The long toes prevent it from sinking into the water or mire. It has long and pointed beak with which it catches fish and other insects which form its chief food.

The Woodpecker.—This bird has four toes, two of them being in front and two behind. As the food is found under the bark of trees, it always lives in the trees. Its toes help it in climbing. When it rests on the bark of a tree in search of worms and insects, it is assisted by its short stiff tail feathers which serve as props against the bark. Then it taps the tree with its long beak. The insects come out of

Fig. 23. Woodpecker.

their hiding places, and the woodpecker catches them with its tongue. Sometimes it bores a hole through the bark with its beak as far as the place where the insects are. Its tongue is wonderfully adapted for catching hold of the tiny worms. It is long and sticky and furnished with barbs at its tip. When the hole is made in the tree, it at once darts forward its long tongue and seizes the insects which stick to it.

The above description of birds shows clearly that their external structure is closely related to their habits. Their beaks and legs are fitted in such a way as to enable them to lead the particular kind of life which they are leading and get the particular kind of food which they require. A carnivorous bird like the kite possesses a strong pointed beak, the upper part being hooked and hence fit for tearing flesh. Water birds like the duck, swan, and goose possess long and flat beaks, the sides of the jaws being provided with fringes which act as strainers. These birds probe in the mud with their beaks and catch hold of worms and fishes. But the stork, the crane, and the heron have long, slender, and pointed beaks

enabling them to thrust them under water to catch fish. The woodpecker which always lives in the trees taps the tree with its long, pointed beak, makes a hole in the bark, and catches the insects with its sticky tongue. The beak of a parrot is short, stout and strong. The upper beak is curved, and pointed while the lower is chisel-shaped. The bird cracks nuts with the beak and eats the pulp inside. Honey-sucking birds like the sun-bird possess long slender beaks with the tips pointed. They thrust their beaks into the flowers and drink the nectar like butterflies.

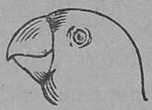


Fig. 24.

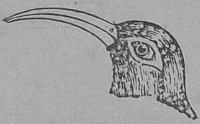


Fig. 25.

Flesh-eating Mammals.—This group includes lions, tigers, cats, dogs, bears, and jackals. These animals are said to be carnivorous. Their teeth and claws are suited for catching and tearing their prey. The teeth of mammals can be mainly divided into four kinds, the incisors, the canines, the premolars, and the molars. In flesh eating forms like the lion and the dog, the canines are well developed to enable them to tear their prey. The cat has a long curved pointed canine tooth on either side of each jaw. Besides the canine teeth, there are sharp-edged cutting teeth behind them. The teeth of a cat are suitable only for biting and tearing and not for chewing. The tongue is very rough, since it contains a large number of

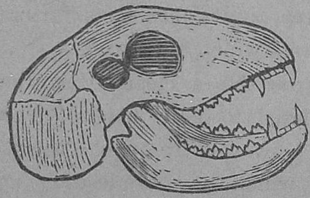


Fig. 26. Skull of a Cat.

projections. These projections are useful in rubbing meat from bones and swallowing.

Herbivorous Mammals.—All the animals of this group are vegetarians. The horse, the sheep, and the cow

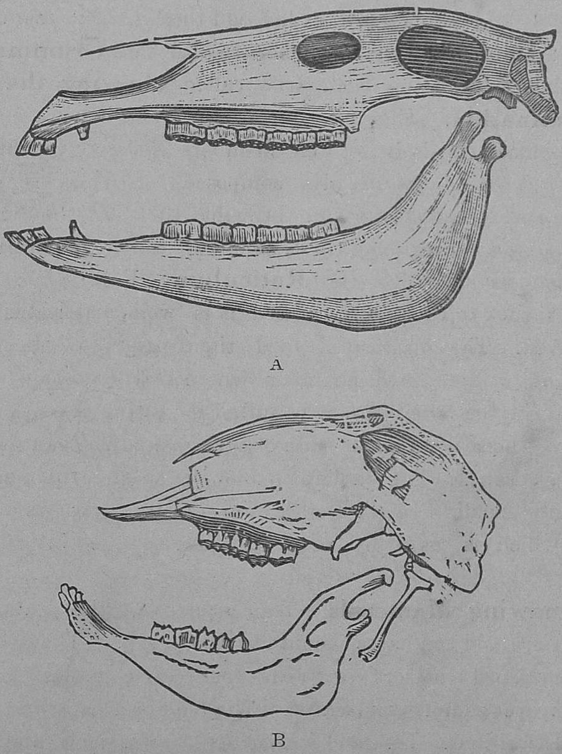


Fig. 27. A. Skull of a Horse. B. Skull of a Sheep.

belong to this group. They have their grinders most perfectly developed to enable them to grind grass well. Their limbs are suitable for long walking or even running, since they have

to go to long distances in search of grass. These animals are also called hoofed animals. They are divided into two classes according to the number of toes they possess. Some are even toed and some are odd-toed. Such animals as the cattle, sheep, and deer are called even-toed hoofed mammals, while the horse and the ass are called odd-toed hoofed mammals. These even-toed hoofed mammals are also called **ruminants,** since they exhibit the peculiarity called **chewing the cud** or **rumination.** They feed on grass. They have a complicated stomach consisting of four chambers as shown in Fig. 28. The food which is mainly composed of grass is swallowed hastily, and later on brought back to the mouth. It first passes through the first chamber called **Rumen** and then the second called the **Reticulum**. From there it is brought back to the mouth where it is well masticated and swallowed. The masticated food then passes to the third and then to the fourth chamber where real digestion takes place. The teeth of a horse are suited for eating grass. There are three incisors on either side of each jaw. The canines are entirely absent. The molars enable the animal to grind the food into small pieces. Before the molars there is a large space which is used by man for placing the bit of the bridle.

Gnawing Mammals.—The squirrels, the rats, the porcupines, and the hares belong to this group. They possess well-developed incisors or front teeth and molars. The canines are completely lacking. The squirrel is found near human dwellings. Its food consists of fruits, seeds, and nuts which it gathers from the trees. The front teeth are admirably adapted for gnawing nuts and seeds. The molars are used for grinding the hard food. The squirrel is an expert climber and a good runner.

Mammals can be divided into two classes flesh-eating and herbivorous mammals according to the kind of food they eat. In flesh-eating forms, the canines are well developed to enable them to tear their prey. Lions, tigers, cats, dogs, and jackals belong to this group. But in herbivorous animals like the horse, the sheep, and the cow, the grinders are well developed to grind grass well, and the canines are entirely absent. The cow and the sheep are called ruminants, since they chew the cud. A horse is non-cud-chewing. The front teeth are chisel-shaped and enable the animal to cut grass, while the back teeth grind it to small pieces. The horse grinds its food first and then swallows it. Squirrels, rats, and porcupines are called gnawing mammals. Their teeth are admirably adapted for gnawing nuts and seeds which form their chief food.

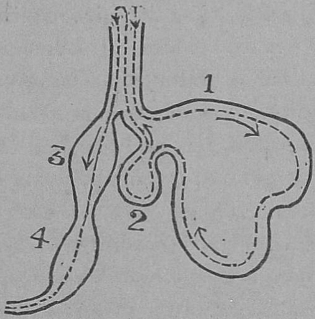


Fig. 28.

CHAPTER IV

BREATHING IN ANIMALS

All animals beginning with the earthworm have respiratory organs. These organs become more and more specialised, among higher animals. In the case of insects like the butterfly or the mosquito, the breathing apparatus is situated in the abdomen. How they breathe is given in detail in page 3.

GILL BREATHING

Breathing in Fishes.--A fish when taken out of the water dies of suffocation since it cannot breathe directly from the atmosphere.

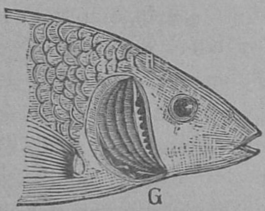


Fig. 29. G : Gills.

The fish takes the air required for it from water. If a live fish be put in water which has been boiled, it dies, because the air required for its breathing has been driven out of the water by boiling. Just where the head is connected with the trunk, there is a slit one on each side of the fish. When the flap near it is lifted, you find the **gills** which serve as breathing organs of the fish. The gills appear red owing to the large number of blood vessels present in them. It may be observed that a fish is constantly opening and closing its mouth. When it opens its mouth, water goes into it bathing the gills. When the mouth is closed, water flows out through the slit. When the water comes in contact with the tiny blood vessels, the blood takes the oxygen dissolved in water, and, in turn, gives out its carbonic acid gas which is washed away by the water. By side of the gills, there is the heart. The blood that has been purified in the gill chambers goes to the different parts of the body, gives out oxygen to them, receives the carbonic acid gas, and is thus rendered impure. The impure blood from the several parts of the body goes to the heart and is pumped from there to the gill chambers to be purified. Thus we find that the blood inside the fish is always kept in circulation from the heart to

the gill chambers, from the gill chambers, to the several parts of the body, and from there back to the heart, and so on.

Breathing in Crabs.—The sea crab (Fig. 18) breathes through the gills near the roots of its eight walking legs. The gill chambers have two holes, one in front and the other at the back. Water enters through the front opening and flows out through the one at the back. The living membrane of the gill chambers is full of blood vessels. The exchange of gases takes place in the gills. When the water comes in contact with the tiny blood vessels, the blood takes the oxygen dissolved in water and in turn, gives out its carbonic gas which is washed away by the water.

Breathing in Frogs.—Breathing is effected partly in the lungs and partly in the skin. The two small openings above the mouth are the nostrils. The frog takes in a quantity of air through the nostrils after closing its mouth. The floor of the mouth is now depressed increasing the capacity of the mouth cavity. When the mouth is filled with air, the nostrils are closed, and the floor of the mouth rises practically closing the throat. The only course left open for the air is to go down the slit-like opening called glottis into the lungs. This process is called inspiration. Since the walls of the lungs are elastic, the expanded lungs now begin to contract. The foul air is forced back through the glottis into the mouth and from there is driven out by the nostrils which open simultaneously. This is what is taking place during expiration. These respiratory movements of a frog are well seen by keeping a live frog under observation.

Let us see how it breathes when it is under water or buried in mud. During this period, the skin plays the part of a respiratory organ, in the same way as the gills of fishes do in absorbing oxygen from water and giving off carbonic

acid gas. In order that the skin may do this efficiently, it must be kept moist. When it becomes dry, the frog dies. Though the frog breathes through the two organs, the lungs and skin, still the quantity of air taken in is so small as not to make the blood warm. Hence it is a cold-blooded animal.

LUNG BREATHING

In the case of higher animals like the reptiles, birds, and mammals breathing is effected wlth the lungs. In the lungs, there is a network of blood vessels. When these animals breathe in, the impure blood comes in contact with the oxygen present in the lungs and is purified, and the carbonic acid gas is driven out when they breathe out.

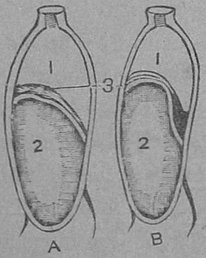


Fig. 30.
A. Inspiration.
B. Expiration.
1. Chest.
2. Abdomen.
3. Diaphragm.

This respiration takes place automatically in man and other mammals without the will of the animal. There is an arch-like partition called the diaphragm dividing the trunk into two halves the upper and the lower. During inspiration, the diaphragm is flattened, the ribs are raised and the capacity of the chest increases. Air from outside rushes into the lungs. During expiration, the diaphragm resumes its original position, the ribs are lowered and the capacity of the chest decreases. The carbonic acid gas is forced out of the lungs. Reptiles and birds have no diaphragm and they use their ribs only in breathing.

CHAPTER V

SPECIAL COVERINGS

In the previous chapters, we have studied that animals like the fish and the lizard have their bodies covered with scales, while birds have their bodies covered with feathers. The bodies of mammals are all covered with hair. In this chapter, we shall study tortoises, turtles, and porcupines with special reference to their coverings.

TORTOISES

Some tortoises live on land; others are to be found in marshes and in fresh water; and others again called turtles

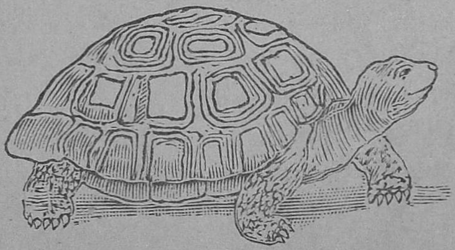


Fig. 31.

Tortoise

live in the sea. Their chief feature is that their bodies are encased in shells resembling boxes. The shell protects the animal from dangers. It is arched above and flat below. At the approach of enemies, the animal withdraws its head and limbs into it. Land tortoises have short limbs, and their shells are more convex than those of turtles, and are so strong and

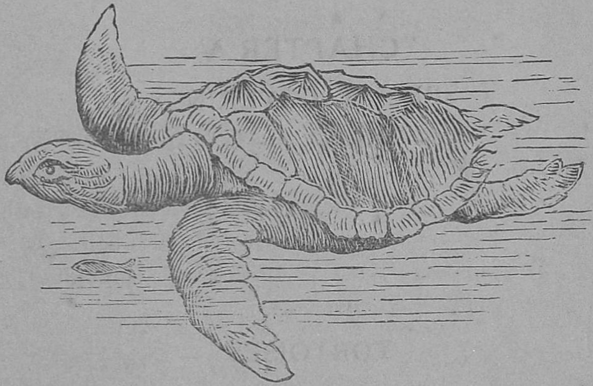


Fig. 32. Turtle.

resisting that a man may stand upon the back without harming them.

PORCUPINES

The common porcupine belongs to the class of mammals. Its body is not thickly covered with hair. It has some of its hairs developed into spines or quills. It carries on its neck a mane of quills. There are two kinds of quills on its back. Some of them are very long, thin, and curved, while others are thick, short, and straight. All the quills have black and white rings. They enable the animal to live in hollows. Whenever it is attacked by other animals, the quills stand erect, and the animal produces a rattle which causes fear among its enemies.

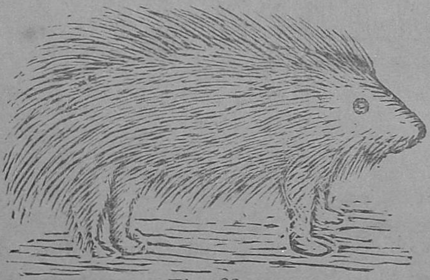


Fig. 33.

CHAPTER VI

COLOURATION

Protective Colouration.—The colour of animals very often harmonises with their surroundings. The adaptability in colour to the environment is strikingly seen among insects in nature. They very closely resemble their surroundings in colour so that they escape detection by their enemies. A grasshopper living in grassy meadows is green in colour, while those living in the soil have the colour of the soil. The colour of a caterpillar resembles that of the leaf on which it is generally found. A butterfly rests on a flower with its wings vertically over its back so that it cannot be easily distinguished from the flower. Nocturnal animals like the bat and the owl possess a dull colour so that they cannot be singled out by their enemies. The colouration in these cases not only affords effective protection but also enables the animals to fall upon their prey unseen.

Warning Colouration—Some insects attract our attention by their clear colouring. Wasps and hornets seen in our houses sometimes possess a bright colour and can be seen clearly in their surroundings. Their enemies associate the bright colour with the powerful stings which the insects possess and so avoid them. The colouration in these cases affords **protection by warning**.

Mimicry.—Some animals are found to imitate other animals totally differing from them in structure and habits with a view to save themselves from their enemies. This is called mimicry. Instances of mimicry are found in abundance in the insect world. Some moths imitate the colour and appearance of the wasp or hornet which is dreaded by other animals on

account of its sting. They develop this habit in them unconsciously with a view to frighten their enemies to escape from them.

Colour Changes.—Some animals often change their colour to suit that of their surroundings. They assume different colours in different surroundings, so that they cannot be easily marked out by their foes. The Polar Bear changes colour during seasons. In winter, it puts on a white dress, since its surroundings are covered with ice. Some frogs, fishes, and lizards can change their colour to suit the environment to a certain extent. The chamelion also changes its colour.

CHAPTER VII

POISON APPARATUS IN SCORPIONS, CENTIPEDES, AND SNAKES,

SCORPIONS

Scorpions are generally found in warm countries, and under stones in dry places. They usually hide themselves under stones during the day being intolerant of heat, and come out at night in search of prey. They feed for the most part on insects and spiders.

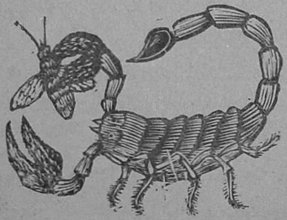


Fig. 34.

The body of a scorpion consists of two regions, the **Cephalathorax** (the region formed by the blending of the head with the thorax) and abdomen. The cephalathorax contains a pair of nipping claws with which it holds its

prey. The Abdomen is very long, distinctly segmented, and differentiated into two portions, the front part and tail. The front part is broad and consists of seven segments of the same diameter. The tail portion is narrow and consists of five segments and a conical joint which contains the poison glands, and which forms a very efficient and powerful sting. The poison apparatus consists of two bags containing the poison. When required, the poison is squeezed out of the bags by muscles and comes out through a tube. As the tail is very mobile, the sting can be readily directed to any point.

CENTIPEDES

Centipedes (hundred feet) so called with exaggeration are readily identified by the large number of feet they possess. If we examine one of the centipedes very closely, we find that the body is divided into a head followed by a narrow segment and then by several segments of different sizes. The

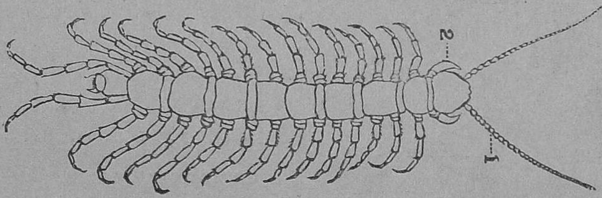


Fig. 35.

1. Antennae. 2. Poison claws.

number of segments varies from ten to seventeen. The head has a pair of long antennae. On the under surface of the head, there is pair of vicious-looking claws, the poison claws. The tip of each of these is perforated, and as the animal strikes its prey, a drop of poison is squeezed out which at once kills any insect or larva which it wishes to eat.

SNAKES

Poisonous and Non-poisonous Snakes.—Snakes can be divided into two classes, poisonous and non-poisonous snakes. The most common poisonous snakes found in the Madras Presidency are the cobra, the viper, and the krait. Their bite almost often proves fatal. The cobra can be easily distinguished by the V-shaped mark on the hood. When it is angry, the neck becomes broad, and the broadened neck is called its hood. All water snakes are non-poisonous.

The Fangs.—Ignorant people imagine that the tongue of the venomous snake is poisonous. It is not so. The tongue is harmless and acts only as feeler. The upper jaw contains two long sharp teeth, one on each side, called **fangs**. They are curved backwards. They do not contain poison and are hollow or grooved. Each fang is connected with a bag (poison gland) at the back of the mouth containing poison. When the snake bites a person, the action of the bite makes the muscles of the poison glands contract, and the poison is squeezed out of the bags and flows along tubes to the base of the fangs. It is then injected into the wound through the hollow fangs.

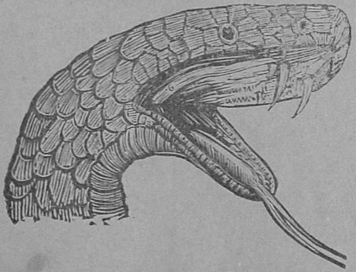


Fig. 36. G. Poison Gland,

Treatment of Snake-bites.—Snake-bite is quite common in India, and many die of it every year. It should be attended to very promptly. Else it proves fatal. The poison should not be allowed to mix with the blood. If it mixes with

the blood, it will be carried away to the other parts of the body. The first thing that you should do is to prevent the spread of the poison by tying a piece of strong cord tightly above the wound. Take a sharp knife and cut the wound crosswise several times. Ask another person to suck the blood. This should be done with care. The person who sucks the blood should have no wound either in the mouth or lips. After sucking the blood, he should spit it and wash his mouth well. If these precautions are not taken, the poison will get into his blood also. Powder some potassium permanganate and thoroughly rub the cut with it. Administer **antivenine** injections, and consult a doctor who is a specialist in snake-bite.

Sloughing.—Snakes cast off their outer skin periodically. This process is called sloughing. The coat (**slough**) that has been removed is very thin and light and may be seen on walls and hedges.

IRRITATING HAIRS IN CATERPILLARS

Caterpillars are worm-like creature coming out of the eggs of butterflies and moths. The skins of some are thickly covered with hairs which serve as protection against enemies. When the hairs come in contact with our skin, they irritate it. The skin becomes red and swollen. When these creatures are devoured by their enemies, the hairs get entangled in the throat and irritate it. Hence the hairs have a great protective value.

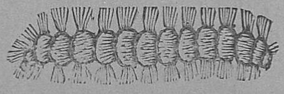


Fig. 37.

HORNS

All horned animals belong to the class of ruminants. There is considerable difference between the horns of an ox and those of the stag. A bullock's horn is hollow, curved, and

tapering to a point. It is hard and tough and has a smooth shiny appearance. It is really a protective covering for the bone beneath. The horns of the sheep, goats, and oxen are hollow and horny. The horns of the deer are quite different from these hollow horns. They consist of a number of spreading branches and are called antlers. These antlers are hard solid bone and not horny matter. They are the continuation of the frontal bone of the skull without any external covering. Only the males have antlers with the exception of the reindeer. The horns of the sheep, goats, and oxen are permanent, while the antlers are shed in the spring of every year. The horns serve as weapons of defence against adversaries. The horns of the ox family are used for making combs, shoe-lifts, and buttons. Those of the deer are used for making handles, for carving-knives and forks and pocket-knives.

CHAPTER VIII

LIFE HISTORIES OF ANIMALS

We have seen that one point of difference between animate and inanimate objects is that the former reproduce their kind. In most animals, sex differences exist. But in the earth-worm, the leech, and the snail, these two sexes exist in the same animal. One part is the female and the other male. Generally it is the female that reproduces the young either by laying eggs and hatching them or by giving birth to young ones. We shall study in this chapter the life histories of a few animals.

BUTTERFLY

There are four stages in the life history of a butterfly. The female butterfly lays eggs on the underside of the leaves of plants. From the eggs came out worm-like creatures called caterpillars. These caterpillars (Fig. 17) feed voraciously on

the leaves. They are quite different from the butterfly, as they have no wings and antennae. They are found to have strong jaws, with which they eat the leaves. They grow very rapidly and cast off their skin several times. When they reach their full size, they no longer eat. Then they pass through the pupa stage in which they neither move nor eat. When they are fully developed, they cast off their skin for the last time. The pupal case bursts open, and the fully developed butterfly comes out. During this stage, complete transformation takes place. The insect is provided with the sucking tube, wings, and legs. From this it is clear that the butterfly passes through four distinct stages, *viz.*, the **egg** stage, the **caterpillar** or **larva** stage, the **pupa** or the **chrysalis** stage, and the **adult insect**.

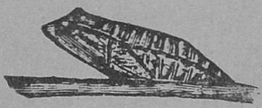


Fig. 38.

Distinguishing Characteristics of Moths.—Though butterflies and moths belong to the same order of insects, still certain characteristic differences exist between them. Moths are seen flying about during nights, while butterflies are day-flyers. The wings of moths are not so brightly coloured as those of the butterflies. The moth's antennae look like feathers, while those of the butterfly are knotted at one end. Moths rest on flowers with their wings spread out, while butterflies do so with their wings folded. Their bodies are broader than those of the butterflies. Even in their life history there is slight difference. The larvae of many moths weave a silky mass of threads (the **cocoon**) about themselves within which they pupate.

Silkworm.—It is the larva of a species of moth called silkworm. The caterpillar of the silkworm feeds on mulberry leaves, and after reaching maturity spins a cocoon of silk in

which it pupates. The cocoon is put in hot water, the pupa is killed, and silk is removed and spun into threads.

MOSQUITO

The female mosquito lays eggs, in small rafts on the surface of stagnant water. The little rafts may contain from 150 to 400 eggs. Under favourable conditions, the eggs hatch into larvae within a day or two. The young larva cuts a hole in the lower end of the egg and goes into the water below. Then it begins to wriggle in the water, and

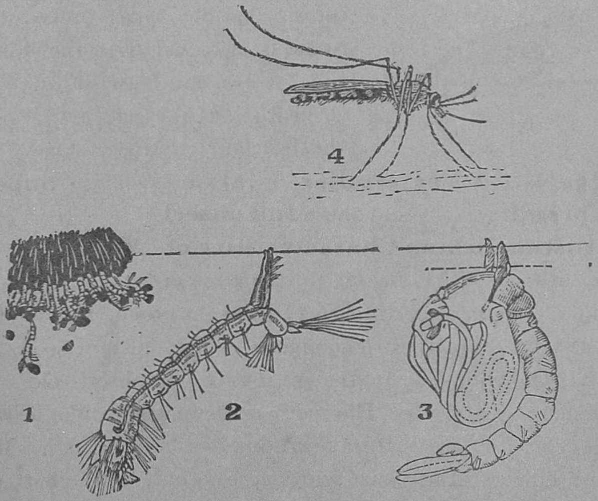


Fig. 39.
1. Egg. 2. Larva. 3. Pupa. 4. Full grown mosquito.

so is called a wriggler. The larva stage which is the second stage in the development of the mosquito lasts for about a week. The larva feeds on the very tiny plants and animals found in the stagnant water, and grows rapidly. It sheds its outer covering very often and forms new and larger coats. The head, the thorax, and the abdomen are formed

during this stage, but not the wings and legs. The wriggler very often comes to the surface of water and gets the necessary supply of air. It hangs head downward, projecting its breathing tube (near the tail end) into the air above. Though it lives in water, still it has to get the supply of oxygen from air. On the eleventh day, it changes into a pupa. The pupa unlike that of other insects is active and moves about. It does not, however, take food. The insect now breathes by means of a pair of tubes in the thorax. During this stage, its legs, wings, and the sucking tube are developed. On the fourteenth day, its skin cracks, and the full grown mosquito leaving its pupal case, flies into the air.

How to get rid of Mosquitoes.—Since mosquitoes spread malaria, yellow fever, and elephantiasis, they must be got rid of. We all know that during the second and third stages of their development, they come often to the surface of water to get their supply of air. This fact is taken advantage of in exterminating them. If enough kerosene oil is poured on the surface of water to form a thin film, the larve and pupae are choked to death, and the female mosquitoes are prevented from laying eggs. The oil has to be renewed once in two or three weeks.

FROG

The female frog lays eggs on water from 1000 to 2000 at a time. The male fertilizes them by shedding a milky substance. The eggs are not hatched by the frog, since it is a cold-blooded animal and has no warmth. They float on the surface of water exposed to the heat of the sun. You may have seen the eggs clinging to the weeds like small black dots. When an egg is hatched by the heat of the sun, a little creature comes out of it having a large head and a long tail. This is the larva of the frog and it is called a tadpole

(tad = tailed, pole = head). The mouth is not yet formed. The larva looks quite unlike a frog, and it takes about two or three months for it to develop into a frog after undergoing several changes. When the food stored in the body of the young tadpole has been used up, the mouth is formed, and the tiny creature is seen moving about lashing its tail in search of water weeds. Three pairs of external gills appear behind the head and act as breathing organs for some time. These gills soon disappear and the tadpole now looks like a fish having

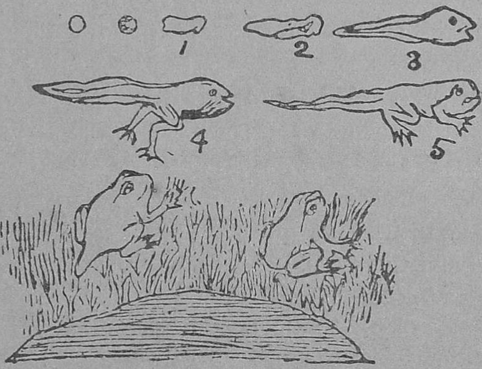


Fig. 40.

internal gills and swimming about with its tail. The body elongates, and the future hind-limbs begin to appear at the base of the tail. Before they are fully developed, the fore-limbs also appear. In the meanwhile, the other organs, the lungs and heart, are developed, and the gills and tail gradually disappear. Then the tadpole leaves the water, and it is fully equipped with all the organs necessary for life on land.

From the life history of a frog, we see clearly that it lives a double life. In the tadpole stage, it breathes through the

gills, but at a later stage, it breathes through the lungs. Hence it is called an **amphibian** (Gr. amphibious—living a double life.)

Sex Differences in Birds.—Birds are exceedingly useful to man. Male birds can be distinguished from females by their brilliant plumage and power of singing. During the breeding season, the male birds attract the female by their power of singing coupled with bright coloured plumage. The peacock possesses brilliant plumage and is seen strutting before the pea-hen to attract it. Another point of difference between a male bird and a female lies in hatching eggs. It is the female that attends to that work, while the male bird goes in search of food. Besides, the males are bigger in size than females.

Oviparous and Viviparous embryo.—Birds differ from mammals in their mode of reproduction. Birds lay eggs, while mammals do not with the exception of some primitive ones. In mammals, the young ones which they give birth to are completely formed. They remain the same throughout their lives and are nourished to grow and become strong. But in the case of birds, the young ones are at first enclosed in eggs in which they develop. They come out of the shells with feet, wings, beaks, and plumes. So mammals are said to be viviparous, while birds are said to be oviparous.

The food necessary for the growth of the embryo in the case of mammals is communicated through the placenta which forms the connecting link between the mother and the unborn young (foetus). The blood vessels of the unborn young come in contact through the placenta with the blood vessels of the mother's womb and take the nutritive materials necessary for its growth from the latter. But in the case of birds, the food necessary for the embryo is stored in the egg. The germinal

vesicle absorbs the white and yellow of the egg and develops into a young bird.

Care of Eggs and Young Ones in Birds.—The method of reproduction in all birds is the same. Birds lay eggs which vary in number, size, and colour. Let us examine the egg of a hen. The egg consists of a hard shell. It is oval in shape. Inside the shell, there is a membrane lining the shell. When the membrane is cut open the liquid contents are visible. They do not completely occupy the egg shell but there is air space between them and the membrane. There are two parts in the liquid contents, the white part and the yellow part which are called the white and yolk of the egg respectively. The yolk contains a white spot which forms the germ, the living part of the egg. The parent bird hatches the eggs and keeps them warm. The germ grows and gradually develops into the young chick. At the end of three weeks (period of incubation), the young chick breaks through the shell, and begins to search for food under the protection of the parent bird. The instinct of protecting the young ones is developed to a greater degree in birds and mammals than in other animals. In some birds, the young ones are fed for a few days by their parents in their nests, until they are able to fly. The shape of the eggs prevents them from falling from the nest, while the colour harmonises with the surroundings and serves as protection from enemies.

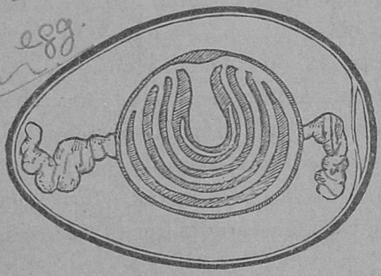


Fig. 41.

Care of young ones in Mammals.—The instinct of protecting the young ones is more fully developed in mammals than in birds. The mothers suckle their young when born and look after them until they can take care of themselves. In the case of human beings, this parental care lasts for several years.

CHAPTER VII

ANIMAL SOCIETIES: ANTS AND BEES

These insects are called social insects, because they live together in colonies. There is division of labour among the several individuals of the same colony, each doing its work with wonderful orderliness and intelligence.

THE HONEY-BEE

External Features.—The honey-bee is a social insect with its body covered all over with hair. The two pairs of wings found in the thorax are membranous, and hence the insect is called a **membranous winged insect**. It possesses three pairs of jointed legs.

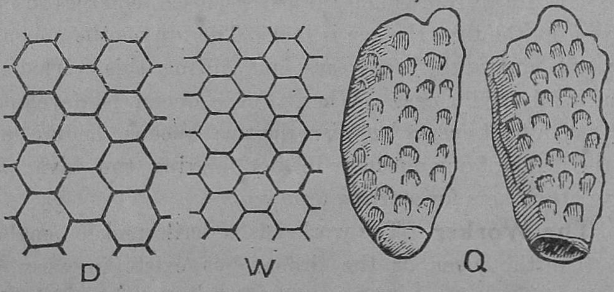


Fig. 42.

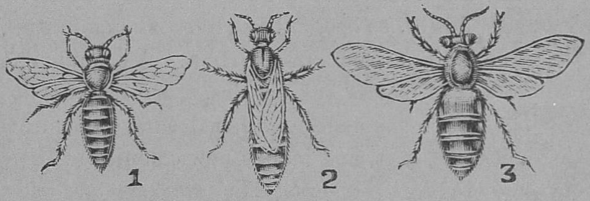
Bee-hive.—It is a nest for the bees to store up honey, In the hive, there are three types of individuals, the queen,

the drone, and the worker. Inside the hive there is the honey-comb, which contains a large number of cells. The most wonderful thing about these cells is their shape. They are six-sided chambers, capable of holding the greatest possible contents and presenting the smallest possible surface. There are three kinds of cells, namely, the drone cells, the worker cells, and the royal cells. The worker cells are small cells used for either storing honey or the development of the workers. The drone cells are larger than the worker cells, and are intended for the development of the drones. The royal cells are irregularly oval in shape, and are reserved for the use of the queens.

The Queen.—The Queen bee is the mother of the colony. She can be distinguished from the others by her long slender body. Her sole business is to lay eggs, and in the course of a day she may lay about 3000 eggs. Her wants are all attended to by the workers. The egg from which the queen develops is laid in a special cell, called the royal cell. During the larva stage, she is fed by the workers on a special diet called the **royal jelly**. The larva or grub then passes through the pupa stage from which the perfect insect emerges in fifteen days from the time the egg is laid. The life of the queen bee varies from two to three years, and during this period she is continually laying eggs. When a new queen is developed in the cell, a fight ensues between the two queens, ending either in the death of one queen or in her leaving the hive with a body of workers for starting a new hive.

The Worker.—The worker is a sterile female smaller in size than the queen or the drone, but exists in very large numbers in a colony of bees. To the worker is assigned the task of building the comb, collecting nectar and pollen from flowers, and storing them in the hive. Its structural adaptations

enable it to do its work properly. Its mouth consists of a long proboscis for sucking nectar from flowers. The nectar is stored in a particular chamber called honey stomach where it changes into honey. When the worker reaches the hive, it deposits the contents of the stomach in the cells. If we examine the hind-legs, we find that they are beautifully fitted for gathering pollen from flowers. They contain a cavity called **pollen-basket**. Below it, there are rows of stiff hairs



1. Worker. 2. Queen. 3. Drone.

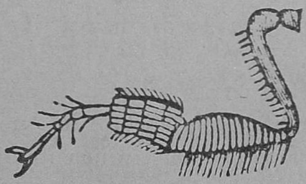


Fig. 43.

called **pollen combs.** The pollen is collected in the baskets with pollen combs, and carried to the hive. The worker bee is provided with a poison sting at the end of the abdomen with which it defends against the attacks of enemies. The sting consists of a pointed structure with little hooks or barbs at the end and is connected with a sac containing poison. Another duty assigned to the worker is to ventilate the hive when necessary and guard the colony from enemies.

The Drone.—It is a lazy creature and does no work. It has a broad abdomen, and is perfectly harmless having no sting. It neither gathers pollen. nor sucks up honey from flowers. Its work is to supply the sperm cells necessary for fertilizing the eggs. When food becomes scarce in the hive, the workers drive out the drones leaving them to starve.

THE ANTS

The ants are social insects and live in ant-hills built underground. Like the bees, they live in communities, and have the same kind of membranous wings. A colony consists of the workers, the males, and females. The workers do not possess wings, while the males and females have them.

The queen lays eggs, and founds new colonies. The grubs are nourished by the workers. The workers are of three kinds, large soldiers, ordinary workers, and small workers. The soldiers possess large heads and powerful jaws. They accompany the workers as guards in their marches. When a colony is disturbed, the ants are seen moving from one place to another. Each ant carries between its jaws the grubs and pupae which ignorant people mistake for grains of rice. It has a poison called formic acid which it injects, when disturbed, and which gives much pain.

PRACTICAL WORK

(1) Dig up some earthworms from the garden, place them on a sheet of glass, and observe their movements.

(2) Place a garden snail on a sheet of glass and observe its movement. Note also the slimy track.

(3) Collect some garden snails, and place them inside a bell-jar containing fresh leaves. Keep them under observation, and observe the leaves after some time.

(4) Examine some living fish in the aquarium. Notice the head, trunk, and tail. Study the several fins and their position. Observe a fish moving, breathing and feeding.

(5) Get a dead fish and examine the gills in the gill chamber.

(6) Collect some caterpillars, in a glass jar with the mouth covered with wire gauze and feed them with fresh leaves. Remove the old leaves and excreta. Watch the changes and note them in your diary.

(7) Get the eggs of mosquitoes from stagnant pools. Keep them in water, and observe the changes.

(8) Collect some eggs of frogs and put them in the school aquarium. Put some green water weeds in it. Observe the changes which take place in the life history of a frog.

Questions

(1) Describe the external features of an earthworm.

(2) How do the setae help the earthworm in its movement ?

(3) Describe the appearance of a garden snail and explain how it protects itself from enemies.

(4) Compare the movement of a snail with that of an earthworm.

(5) Describe the mouth parts of a snail and explain why it is called a punching snail.

(6) What do you understand by the term 'insect'? Describe the general plan of the bodily structure of insects.

(7) Describe the mouth parts of a butterfly, and explain how they are suitable for the kind of food it takes.

(8) What are the several stages in the life history of a butterfly? Explain them clearly.

(9) Mention the chief differences between a moth and a butterfly.

(10) Describe briefly the life history of a mosquito.

(11) What steps would you take to exterminate mosquitoes?

(12) What are social insects? Why are they so-called?

(13) Describe the worker bee and explain the work assigned to it.

(14) Explain how the bees have shown their intelligence in constructing the honey-comb.

(15) Describe the external features of a grasshopper and explain how its mouth parts are fitted for cutting grass.

(16) Describe the external features of a fish and explain how they help it for an aquatic existence.

(17) What are gills? Explain how a fish breathes.

(18) What are cold-blooded animals? Explain why fishes and frogs are called cold-blooded animals.

(19) Describe the external features of a frog and explain how it is fitted to hop on land and swim in water.

(20) Describe how a frog breathes and point out clearly what happens to the several organs involved during breathing.

(21) Describe briefly the life history of a frog and explain why it is called an amphibion. Draw a diagram illustrating the same.

(22) Show, with the aid of a diagram, how a frog uses its tongue for feeding.

(23) Though a snake is devoid of limbs, still it moves swiftly and easily. Explain how it is able to do so.

(24) Describe the poisonous fangs of a snake and explain how it injects its poison.

(25) Describe the wing of a bird and compare it with that of a bat. Explain clearly how a bird uses its wings in flight.

(26) How are birds classified? Explain, with suitable diagrams, how the feet and beaks of birds are adapted to their modes of life.

(27) Draw a diagram of a bird's egg showing its chief parts. State the use of each part.

(28) What are mammals? Why are they so called? Describe any carnivorous mammal you have studied and explain how its teeth are adapted to the kind of food it takes.

(29) Give an example of a ruminant. Explain the process of chewing the cud.

(30) Describe briefly the several ways by which animals are able to protect themselves from their enemies.

(31) Compare the poison apparatus of a scorpion with that of a centipede.

(32) Describe briefly the leg of a lizard and explain how it is able to walk on the ceiling upside down.

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1. Why are some animals called 'carnivorous animals?' How do these differ from the 'herbivorous' ones? Give *four* examples of each.

2. Where are the following animals generally found, and what do you know about their movements:—(*a*) fish, (*b*) lizard, (*c*) snake, (*d*) turtle, (*e*) locusts and (*f*) snail?

3. State briefly what you know about the following:—(*a*) caterpillar, (*b*) honey-bees, (*c*) louse.

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1. Write brief notes on the following:—(*a*) gills, (*b*) mimicry.

2. What do you know about the food of the following animals:—(*a*) leech, (*b*) butterfly, (*c*) snail, (*d*) crab, (*e*) snake, (*f*) squirrel? State briefly how they manage to get their food.

3. Distinguish between 'oviparous' and 'viviparous' embryo. What do you know about the 'care of the young' among (*a*) birds, (*b*) mammals? Give suitable examples.

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